FLOOD PLAIN MANAGEMENT RESTUDY

OF SPRING CREEK

IN THE VICINITY OF KILLDEER

DUNN COUNTY, NORTH DAKOTA

Prepared by

United States Department of Agriculture
Soil Conservation Service
Bismarck, North Dakota

For the

City of Killdeer

In cooperation with the

Dunn County Water Resource District
Dunn County Soil Conservation District
and the
North Dakota State Water Commission

893423

FOREWORD

The Flood Plain Management Study defines the flood characteristics of Spring Creek at the city of Killdeer, Dunn County, North Dakota. Adjacent land uses are transportation, residential, commercial, agricultural, recreational and industrial. With the advent of oil and natural gas development, coal gasification and electric generating plants, there is increasing pressure for flood plain development.

This cooperative report will provide the guidance to local officials in planning land use and regulating development within the Spring Creek Flood Plain. The 10-, 50-, 100- and 500-year frequency floods were selected to represent varying degrees of major flooding that could occur in the future. The 100-year[1/] and the 500-year[2/] frequency floods are necessary for planning land use and development in the flood plain. Flood hazard photomaps show the approximate areas subject to inundation by the 100- and 500-year flood events. Flood profiles show the water surface elevations for the selected events. Typical valley cross sections are presented to indicate ground levels and overlying flood depths across the valley. All data is based on conditions at the time of study (1986).

This report does not imply any federal authority to zone or regulate use of the flood plains; authority to zone and regulate rests with state or local governments. Technical data is provided for potential future adoption of local land use controls to regulate flood plain development. Since this report identifies flood problems it will give guidance to development, with

1/ A flood which has a 1 percent chance of occurrence being equaled or exceeded in any year (also called "base" flood).

2/ A flood which has a 0.2 percent chance of occurrence being equaled or exceeded in any year.

environmental considerations, of flood damage reduction techniques such as flood control structures, removal of obstructions and floodproofing for use in an overall Flood Plain Management Program.

The assistance and cooperation of the city of Killdeer, Dunn County Water Resource District, Dunn County Soil Conservation District, North Dakota State Water Commission and private citizens in carrying out this study are appreciated.

SPRING CREEK FLOOD PLAIN MANAGEMENT RESTUDY
IN THE VICINITY OF KILLDEER

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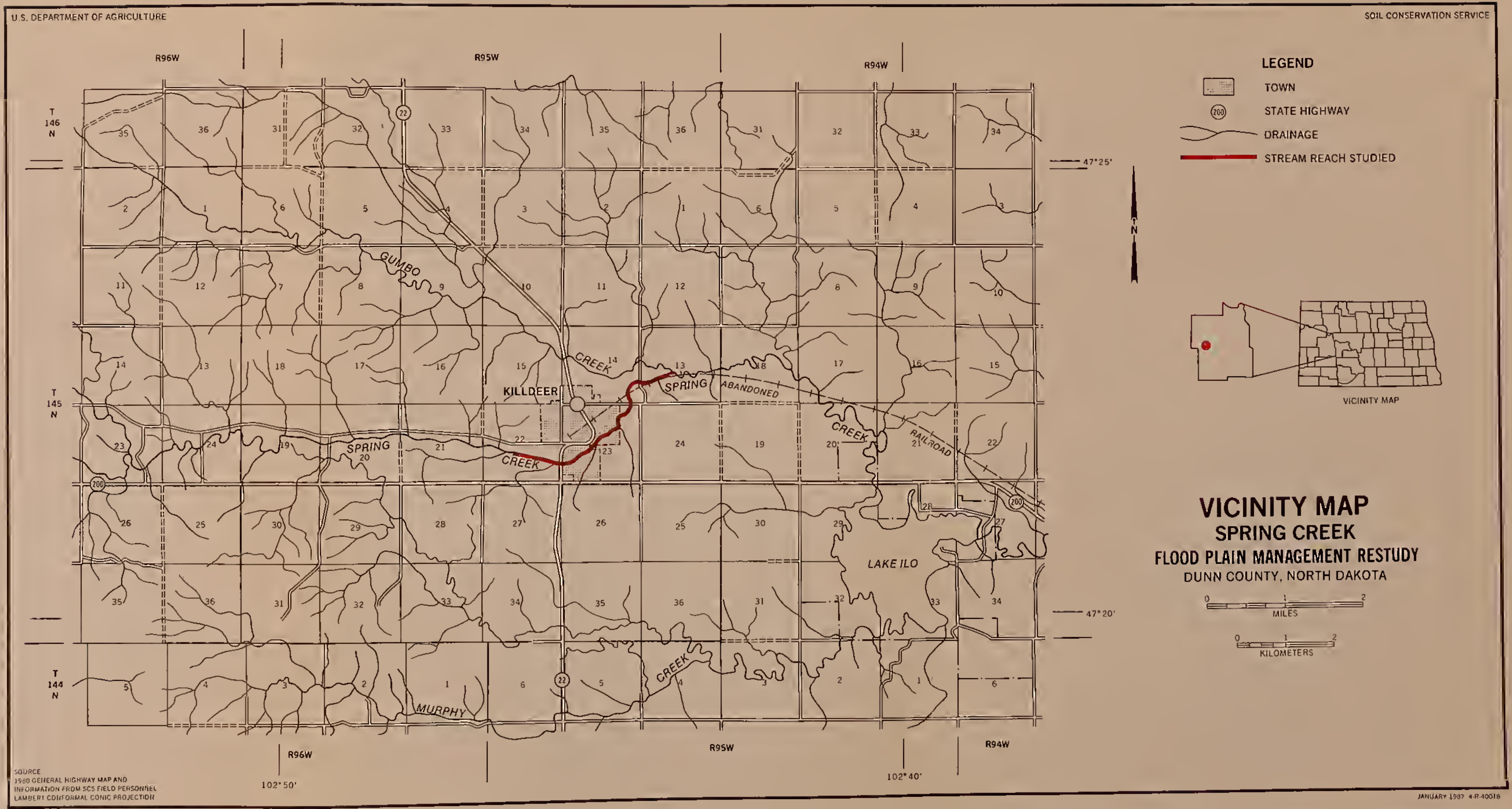


USDA SCS NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX 1987

INTRODUCTION

The purpose of this cooperative restudy is to identify flood hazard areas along Spring Creek in and adjacent to the city of Killdeer, North Dakota, and provide technical data necessary to implement an effective local flood plain management program. The restudy is necessary due to an error in a previous study and subsequent development in the city of Killdeer since that study. The city development includes a subdivision, channel realignment between river miles 107.43 and 108.12, and the removal of two low water crossings.

Competition for land is increasing pressure to develop flood plain areas. Increasing land values and scarcity of undeveloped areas in which to expand often results in flood plain encroachment. Flood plain encroachment frequently results in reduced flood conveyance causing increased flood stages and overall flood losses.

With federal laws governing financing within flood plains, many financial institutions are reluctant to lend unless there is assurance that the area is flood free or can be protected. Federal agencies cannot finance projects in unprotected flood prone areas.

It is imperative that flood plains in agricultural areas be defined for the planning and location of farmsteads and to identify those areas where flood control measures can be applied.

This flood hazard restudy was requested by the Dunn County Water Resource District and the Dunn County Soil Conservation District, through the North Dakota State Water Commission, under the 1978 Joint Coordination Agreement with the Soil Conservation Service. Priorities regarding such studies are set by the North Dakota State Water Commission. The restudy authority is in accordance with the October 1985 Plan of Study between the Dunn County Water Resource District, Dunn County Soil Conservation District, the North Dakota State Water Commission and the Soil Conservation Service.

The flood plain management restudy evaluates 3.86 river miles of Spring Creek. The restudy begins at river mile 105.12 of Spring Creek and proceeds upstream along Spring Creek to river mile 108.98, approximately 1/2 mile west of State Highway 22. Spring Creek river miles 0.0 to 18.32 were included in the Knife River Flood Hazard Analyses, published January 1977. The Spring Creek Flood Hazard analyses, published June 1982, extended the study from river mile 18.32 to river mile 110.99. This restudy includes river mile 105.12 to river mile 108.51.

The "Extra Territorial Jurisdiction Law", passed by the 1975 North Dakota Legislature, provides communities with authority to zone outside the corporate limits. The 1981 North Dakota Legislature amended and re-enacted the law to include each quarter-quarter section within one-half mile of the corporate limits for incorporated cities with a population of 5,000 or less. The extra territorial jurisdiction for the city of Killdeer is covered by this restudy.

Flood plain management studies carried out by the Soil Conservation Service result from recommendations found in <u>A Report by the Task Force on Federal Flood Control Policy</u>, House Document No. 465 (89th Congress, second session), Recommendation 9(c), "Regulation of Land Use".

SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management", and Section 6 of Public Law 83-566. The principles contained in Executive Order 11988, Flood Plain Management, directs that "all executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved."

Potential users of flood plains should base planning decisions upon the advantages and disadvantages of each location. Potential flood hazards are often unknown and consequently the managers, potential users, and occupants cannot always accurately assess these risks. In order for a local flood plain management program to be effective in the planning, development and use of flood plains, technical expertise is needed to collect, evaluate and interpret flood hazard data to help establish local flood plain management programs. SCS will:

1. Assist the state and local units of government by preparing appropriate technical information and interpretations for use in their flood plain management programs.

2. Provide technical services to managers of flood plain property for community, industrial and agricultural uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and organizations.

This report contains aerial photomaps, water surface profiles and typical valley and channel cross sections indicating the extent of flooding which can be expected on Spring Creek. The 10-, 50-, 100- and 500-year frequency flood discharges and elevations are included.

The North Dakota State Water Commission or the Soil Conservation Service will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information developed in this study.

STUDY AREA DESCRIPTION

The study area of the Spring Creek Flood Hazard Analyses is located in the Water Resource Council's Missouri Region and Subregion 10130201.

The climate in the area of Spring Creek is the continental type, typical of the Northern Great Plains. The temperature fluctuates over a wide range with a

mean annual temperature of about 40.6° F, and recorded extremes of -52° F and +111° F. The mean temperatures for January and July are 10.3° F and 69.5° F respectively.

The average annual precipitation for the area is about 15.5 inches, with about 72 percent occurring throughout the growing season. The growing season varies considerably from year to year but averages about 121 days. On clear days the sun shines for more than 15 hours from mid May to the end of July. Average dates for the first and last killing frosts are September 19 and May 21.

The Spring Creek drainage lies within the glaciated portion of the Missouri Plateau physiographic area. It has surface features typical of both glaciated and unglaciated areas. Portions of the uplands are covered by glacial drift with typical ground moraine topography. In some areas the glacial drift thins, becomes patchy, and finally disappears except for a few erratic boulders of granite and limestone that remain on the surface of the ground.

Spring Creek flows in a preglacial bedrock valley. A striking topographic feature of the Spring Creek area is the series of trenches that cross the area from northwest to southeast with little regard for the major drainage pattern. Although some of these valleys are large, they contain only small streams and in some segments have no streams at all. These are believed to have been cut by waters flowing at or near the margin of an ice sheet. These valleys and the Spring Creek valley have wide, nearly flat floors and are generally underlain by glaciofluvial sands and gravels and mantled with recent and modern alluvium. The gradient of the flood plain averages about 9 feet per mile.

Spring Creek has its source on the southeast flank of a prominent rise known as the Killdeer Mountains. Bedrock of the area includes the Tertiary Palocene non-marine Sentinel Butte and Tongue River formations. Overlying these formations are the Eocene Golden Valley formation and the Oligocene White River formation. The formations consist of continental deposits of shale, clay, freshwater limestone, sandstone and lignite.

Spring Creek flows in a nearly level valley with bottomlands averaging less than one-half mile in width and ranging from 5 to 15 feet above the river channel. The river channel meanders extensively.

NATURAL VALUES

"Floodplains including their land and water ecosystems, have evolved from natural forces over tens of thousands of years. Yet, after two centuries of our Nation's history, the natural values of most of our floodplains have been significantly altered. Thus, there is a national concern to carefully manage the remaining natural values of floodplains." 1/

The Spring Creek Flood Plain Management Restudy consists of the floodplains and similar adjacent resource areas. The natural values discussion includes nearly three miles of stream channel and adjacent areas in the restudy area, which includes the west half of Section 13, all of Sections 14 and 23, and the east half of Section 22.

Within the restudy area, approximately one percent is considered prime farmland, 12 percent is additional farmland of statewide importance, 10 percent is additional farmland of local importance, 28 percent is considered the Killdeer area of incorporation, and the remaining 49 percent other nondesignated categories.

There are approximately 161 acres of wetlands, types 1, 2, 3 and 4 primarily occurring in soils map unit 105, and 19 acres of scattered wooded areas occurring in the restudy area. These wetlands and woodlands provide habitat for various wildlife species using the flood plain and adjacent areas including: deer, antelope, fox, coyote, mink, raccoon, jack rabbit, pheasant, partridge, grouse, ducks, geese, doves, numerous song birds and other nongame species. Some of the major woody species include green ash, cottonwood, willow, chokecherry, juneberry, currant, elm, silver buffaloberry, and hawthorne.

1/ "A Unified National Program for Floodplain Management," March 1986, Federal Emergency Management Agency, Interagency Task Force on Floodplain Management.

Naturally occurring beneficial flood plain values in the restudy area have been significantly affected by human actions. These actions have removed conditions under which natural processes can continue. Some of those actions include wetland destruction, paving, roofing, deep foundations, buildings, roads, dikes and dams, as well as, fertilizers, chemical and petroleum spills and leached products of waste disposal areas.

Flood plains in their natural or relatively undisturbed state provide three sets of natural and beneficial resources and hence resource values: (1) water resource values including natural moderation of floods, water quality maintenance, and groundwater recharge; (2) living resource values including large and diverse populations of plants and animals; and (3) cultural resource values including historical, archeological, scientific, recreational, and esthetic sites. [2/]

Flood plain natural values management and re-establishment should be considered in the restudy area. The following examples of practices would be beneficial to flood plain values:

1. Minimize flood plain fills.

2. Relocate structures out of the flood plain.

3. Restore and preserve natural drainage routes.

4. Prevent additional wetland destruction and channelization, restore damaged wetlands.

5. Support agricultural and urban practices that minimize water quality degradation, such as controlled use of pesticides, herbicides and fertilizers.

6. Limit field size. Promote fence rows, field windbreaks and strip-cropping.

7. Design structural upstream projects for runoff detention.

8. Re-establish damaged flood plain ecosystems.

9. Maintain existing riparian vegetation as a green belt.

2/ "A Unified National Program for Floodplain Management," March 1986, Federal Emergency Management Agency, Interagency Task Force on Floodplain Management.

The study area is not presently, nor is it proposed to be, listed in the National Wild and Scenic Rivers System. No critical habitats for threatened or endangered species were identified in the study area.

The 1978 Stream Evaluation Map - State of North Dakota, classifies this stream reach as a high-priority fishery resource (value Class II). This classification extends to a point approximately 3 miles downstream, where the stream enters Lake Ilo, part of Lake Ilo National Wildlife Refuge. Below Lake Ilo the stream is classed as a high-valued fishery resource to its confluence with the Missouri River.

Cultural resource impacts have often been overlooked, especially those resulting from flood plain development and modification. Historical, archeological and scientific, as well as esthetic sites, are often degraded or destroyed by accelerated runoff, blocked runoff, interrupted groundwater flow and increased pollution loadings. Poor agricultural land use practices can be just as destructive of flood plain values as the more obvious structural forms of development. 3/

Cultural resource information obtained from the State Historical Society indicates five sites have been identified within the restudy area. They occur as follows: lithic scatters in Sections 13 and 14, a bridge common to Sections 14 and 23, a post office common to Sections 12 and 14, and a paleontological site in Section 23.

FLOOD PROBLEMS

Most of the flooding occurs in the spring of the year, usually in March and April. Large floods generally occur from spring snowmelt runoff due to winter accumulation of snow and frozen soil conditions. Recent large floods from snowmelt runoff occurred in April 1952, March 1960, April 1969, and March 1972. Earlier floods occurred in 1902, 1913, and 1943.

3/ "A Unified National Program for Floodplain Management," March 1986, Federal Emergency Management Agency, Interagency Task Force on Floodplain Management.

Potential flood areas within the study area include residential, commercial, and agricultural land. Flood damages include eroded land, sediment deposition, crop damage, and weakened roads and bridges.

Upland agricultural drainage, restrictive bridges and limited channel capacity contribute to the severity of flooding within the study area.

Duration of flooding normally ranges from 2 to 5 days for significant flood events.

A 500-year frequency flood within the study area will inundate approximately 420 acres. A 100-year frequency flood will inundate approximately 330 acres.

EXISTING FLOOD PLAIN MANAGEMENT

With flood hazard information, the community can minimize future flood losses by planning for the protection of existing structures within the flood plain area. Overall planning strategies for industrial, commercial and residential areas, streets, utilities, parks, and schools must recognize the need to develop outside the flood plain.

A coordinated planning procedure such as this is a vital part of any comprehensive flood plain management program. Effective flood plain management involves public policy and action for the wise use and development of the flood plain. It also includes such measures as collection and dissemination of flood control information, acquisition of flood plain lands, construction of control structures, and enactment of ordinances and statutes regarding flood plain land use and development.

A viable local flood plain management program is comprised of numerous elements. These include administrative actions, structural measures, and nonstructural measures, to reduce the impact of flooding. Administrative actions include land use regulations such as zoning, building codes, or flood insurance. Structural measures include such things as channel work, dikes, or

floodwater retarding dams. Nonstructural measures include relocation of existing flood plain properties to flood free areas, floodproofing, floodwarning systems, and flood plain acquisition.

Flood Control Measures

Structural flood control measures that can be used to reduce the flooded area include enlarged bridge openings, dikes, floodwater retarding dams, floodways, open channels, or a combination of measures.

Flood Plain Regulations

Flood plain regulations are designed to permit realistic use of flood plain areas without increasing potential damage. Among the various elements used to accomplish this are zoning ordinances, subdivision regulations, building codes, and sanitary and utility regulations. For a guide, see "A Perspective on Flood Plain Regulations for Flood Plain Management", Corps of Engineers Manual EP 1165-2-304.

Flood Insurance

Under the National Flood Insurance Act of 1968 (PL 90-448), the Federal Emergency Management Agency (FEMA), Federal Insurance Administration (FIA), is authorized to carry out a National Flood Insurance Program (NFIP). This program makes flood insurance coverage available to all walled and roofed structures and their contents used for residential, business or nonprofit, religious, agricultural and governmental purposes. The study area is currently eligible to participate in the National Flood Insurance Program. In participating areas, owners and occupiers of all buildings and mobile homes are eligible to obtain flood insurance coverage. It is recommended that persons within or adjacent to the delineated flood hazard areas maintain flood insurance on both the structure and contents.

Further inquiries about the flood insurance program should be directed to the Office of the State Engineer, North Dakota State Water Commission, the official state coordinating agency for flood insurance.

Other Measures

Land use and other regulatory controls including zoning, subdivision regulation and building codes play an important role in flood plain management. In order for these measures to be effective, it is important that the community takes action to implement other programs and measures to supplement these controls. A few possible measures to protect and control developments in flood prone areas are: (1) open space land acquisition programs, (2) urban renewal programs, (3) preferential tax assessment, (4) flood proofing of existing structures, and (5) public policy governing the construction of utilities and public facilities such as bridges and streets.

The Office of the State Engineer, upon request, will provide assistance in flood proofing techniques, the implementation of a flood warning system and establishment of a local flood data collection program.

Alternatives For Flood Plain Management

Some specific alternatives for alleviating the flood situation within the study area are:

1. Adopt local land use and zoning regulations for all flood plain areas. The basic purpose of flood plain regulations is to control development on the flood plain consistent with nature's needs for conveyance of flood flows.

2. Flood proof existing buildings that otherwise cannot be adequately protected. (See U.S. Army Corps of Engineers "Manual of Flood Proofing Regulations", EP 1165 2 314 and "Elevated Residential Structures Reducing Flood Damage Through Building Design: A Guide Manual", published by the Federal Insurance and Hazard Division, HUD).

3. Use as much of the flood hazard areas as possible for parks and other open space uses.

4. Increase the areas of bridge and culvert openings to minimize restrictions. As an example, the abandoned railroad bridge located at mile 105.89 could be removed lowering the 100-year flood elevation from mile 105.89 to 106.04 by 0.2 feet. This is an undeveloped area however, and the cost of removal would exceed the benefits, so removal is probably not practical at this time.

5. The channel realignment from mile 107.43 to mile 108.12 and removal of low water crossings at mile 107.45 and mile 107.52, as proposed by the local developer, varies the 100-year flood elevation from no change at mile 107.43 to 2.0 feet reduction at mile 108.12 (see Appendix C).

GLOSSARY

Acre-Foot -- The amount of water that will cover one acre to a depth of one foot. Equals 43,560 cubic feet.

Backwater -- The resulting high water surface in a given stream due to a downstream restriction or high stages in an intersecting stream.

Channel -- A natural or artificial watercourse with definite bed and banks to confine and conduct continuously or periodically flowing water.

Cubic Feet Per Second -- Rate of fluid flow at which one cubic foot of fluid passes a measuring point in one second (cfs).

Discharge -- The rate of flow or volume per unit of time. In this report discharge is expressed in cubic feet per second (cfs).

Flood -- An overflow of water onto lands not normally covered by water. The inundation is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake or other body of standing water.

Flood Frequency -- An expression of how often a flood event of a given magnitude will, on the average, be equaled or exceeded. The word "frequency" often is omitted in discussing a flood event for the purpose of abbreviation.

Examples"

10-year flood or 10-year frequency flood - the flood which can be expected to be equaled or exceeded on an average of once in 10 years; and which would have a 10 percent chance of being equaled or exceeded in any given year.

50-year flood - ...two percent chance...in any given year.

100-year flood - ...one percent chance...in any given year.

500-year flood - ...two-tenths of one percent chance...in any given year.

Flood Peak or Peak Discharge -- The highest stage or discharge attained during a flood.

Flood Plain, Flood Prone Area or Flood Hazard Area -- Land adjoining a stream (or other body of water) which may be temporarily covered by flood water.

Flood Plain Encroachment -- Placement of fill or structures in the flood plain which may impede flood flow and cause backwater.

Flood Proofing -- A combination of structural provisions, changes or adjustments to properties and structures subject to flooding for the reduction or elimination of flood damage to properties, water and sanitary facilities, structures and contents of buildings in a flood hazard area.

Flood Routing -- Computation of the changes in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

Flood Stage -- The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area.

Hydrograph -- A plotted curve showing the rise and fall of flood discharge with respect to time at a specific point on a stream.

Natural Storage Area -- In this report, refers to depressional areas, marshes, lakes and swamps that temporarily store a portion of the surface runoff.

Natural Values -- Values existing in a area undisturbed by the influence of civilization and society.

Riparian Land -- Land situated along the bank of a stream or other body of water.

Runoff -- In this report, refers to the portion of precipitation (including snowmelt) that flows across the land surface and contributes to stream or flood flow.

Stage Discharge Curve -- A plotted curve showing the variation of discharge with water surface elevation at a point on a stream.

Stage-Storage Curve -- A plotted curve showing the accumulated storage available for floodwater upstream from a point on a stream versus the stage at that point.

Valley Cross Section -- The relationship of the elevation of the ground to the horizontal distance across a valley perpendicular to the direction of flow.

Watershed -- A drainage basin or area which collects and transmits runoff to the outlet of the basin.

Watershed Boundary or Drainage Boundary -- The divide separating one watershed from another.

Water Surface Profile -- The relationship of water surface elevation to stream channel elevation at points along a stream, generally drawn to shown the water surface elevation for the peak of a specific flood, but may be prepared for conditions at any given time.

BIBLIOGRAPHY AND REFERENCES

Executive Order No. 11988, Flood Plain Management, May 24, 1977.

Federal Emergency Management Agency, Interagency Task Force on Floodplain Management, "A Unified National Program for Floodplain Management," March 1986.

Housing and Urban Development, Federal Insurance and Hazard Division, Elevated Residential Structures Reducing Flood Damage Through Building Design.

National River Basins Bulletin No. 15-0-6, February 22, 1980.

North Dakota Century Code, "Extra Territorial Jurisdiction," Section 40-47-01, 1975.

Public Law 83-566, Watershed Protection and Flood Prevention Act of 1954.

Public Law 90-448, National Flood Insurance Act of 1968.

A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress, Second Session).

Soil Conservation Society of America, "Resource Conservation Glossary," 1976.

United States Department of Agriculture, Soil Conservation Service, "Hydrology, Section 4," National Engineering Handbook, August 1972.

United States Department of Agriculture, Soil Conservation Service, in cooperation with the North Dakota Agricultural Experiment Station, Soil Survey of Stark County, North Dakota, February 1968.

United States Department of Army, Corps of Engineers, Manual of Flood Proofing Regulations, EP 1165 2 314.

United States Department of Army, Office of the Chief of Engineers, "A Perspective on Flood Plain Regulations for Flood Plain Management," Washington, D.C. 1976.

United States Department of Army, Office of the Chief of Engineers, "Flood Proofing Regulations," Washington, D.C., 1972.

United States Geological Survey, "Water Resources Data for North Dakota," Annual-Water Data Report.

United States Water Resources Council, "Guidelines for Determining Flood Flow Frequency," Bulletin No. 17A of the Hydrology Committee, Washington, D.C., Rev. June 1977.

United States Water Resources Council, Regulation of Flood Hazard Areas, Volumes 1 and 2, United States Government Printing Office, Washington, D.C., 1971 and 1972.

Figure 2 - M105.64 between Sections 13 and 14, T. 145 N., R. 95 W.

Figure 3 - M106.04 between Sections 14 and 23, T. 145 N., R. 95 W.

Figure 4 - M107.40, Low Water Crossing on Farm Drive in Section 23, T. 145 N., R. 95 W.

Figure 5 - M107.45, Private Low Water Crossing in Section 23, T. 145 N., R. 95 W.

Figure 6 - M107.52, Temporary Crossing in Section 23, T. 145 N., R. 95 W.

FLOOD HAZARD AREA PHOTOMAPS

APPENDIX A

U.S. DEPARTMENT OF AGRICULTURE

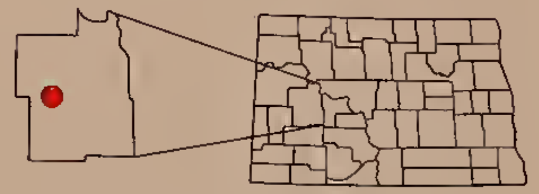
SOIL CONSERVATION SERVICE

LEGEND

3 SHEET COVERAGE

FLOOD PLAIN AREA (100 AND 500 YEAR FREQUENCY FLOODS)

STREAM CHANNEL



INDEX TO MAP SHEETS
SPRING CREEK
FLOOD PLAIN MANAGEMENT RESTUDY
DUNN COUNTY, NORTH DAKOTA

0 — 1 MILES

0 — 1 KILOMETERS

SOURCE
JUNE 1980 AERIAL PHOTOGRAPHY FROM KBM, INC
AND INFORMATION FROM SCS FIELD PERSONNEL

USDA SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX 1987

JANUARY 1987 4-R-40018

LEGEND

	100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)	M 108.98	VALLEY SECTION	105	SOILS AREA AND SYMBOLS
	500 YEAR FREQUENCY FLOOD	^2235^	ESTIMATED 100-YEAR FLOOD ELEVATION	R.M. S-84A	REFERENCE MARKS
	STREAM CHANNEL				

SCALE 0 400 800 FEET
0 100 200 METERS

JUNE 1980 AERIAL PHOTOGRAPHY FROM KBM, INC.

DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT, THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION

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U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SPRING CREEK
FLOOD PLAIN MANAGEMENT RESTUDY
DUNN COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

SPRING CREEK

JANUARY 1987 4-R-40018

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 108.98 VALLEY SECTION

^2235^ ESTIMATED 100-YEAR FLOOD ELEVATION

105 SOILS AREA AND SYMBOLS

R.M. S-84A REFERENCE MARKS

SCALE 0 400 800 FEET; 0 100 200 METERS

JUNE 1980 AERIAL PHOTOGRAPHY FROM KBM, INC.

DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT, THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION

SHEET 2 OF 3

U.S. DEPARTMENT OF AGRICULTURE
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SPRING CREEK
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FLOOD HAZARD AREA

SPRING CREEK

LEGEND

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)
500 YEAR FREQUENCY FLOOD
STREAM CHANNEL
M 108.98 VALLEY SECTION
2235 ESTIMATED 100-YEAR FLOOD ELEVATION
105 SOILS AREA AND SYMBOLS
R.M. S-84A REFERENCE MARKS

SCALE 0 400 800 FEET
0 100 200 METERS

JUNE 1980 AERIAL PHOTOGRAPHY FROM KBM, INC.
DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT, THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION

SHEET 3 OF 3

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SPRING CREEK
FLOOD PLAIN MANAGEMENT RESTUDY
DUNN COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

SPRING CREEK

APPENDIX B

EXISTING BRIDGES AND CULVERTS

Bridges and culverts existing at the time of study and used to develop the water surface profile data contained in this document are shown pictorially on the following pages.

The pictures should be helpful in the future to visually check which bridges were in place at the time of study, which were restrictive or in need of replacement and which have been subsequently replaced thus affecting localized flood plains.

M-107.45 Private Drive in Section 23
T. 145 N., R. 95 W.

M-107.52 Temporary Crossing in Section 23,
T. 145 N., R. 95 W.

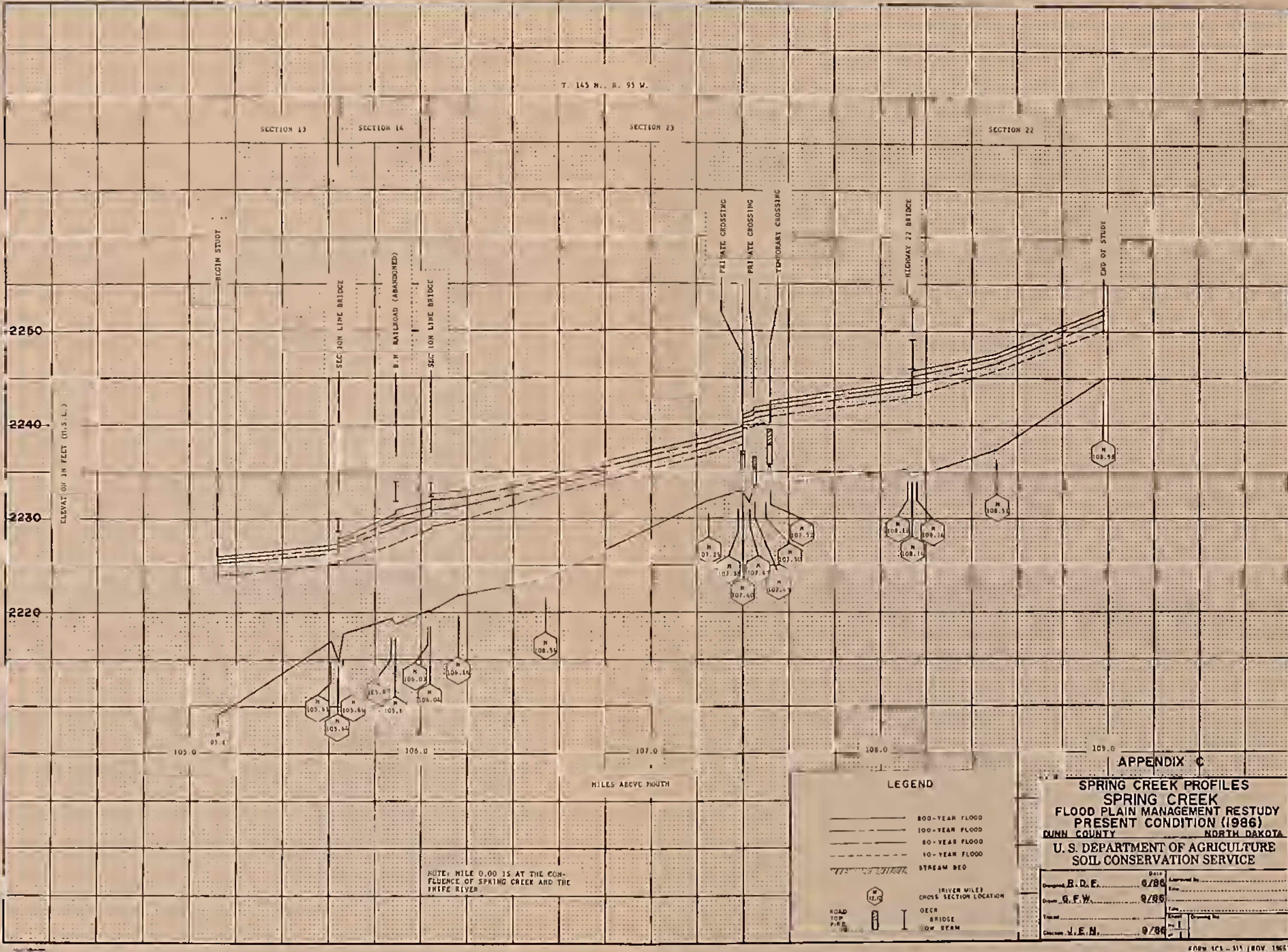
M-108.14 Sections 22 and 23, T. 145 N., R. 95 W.
ND Highway No. 22

M-105.89 Burlington Northern Railraod Bridge
Section 14, T. 145 N., R. 95 W.

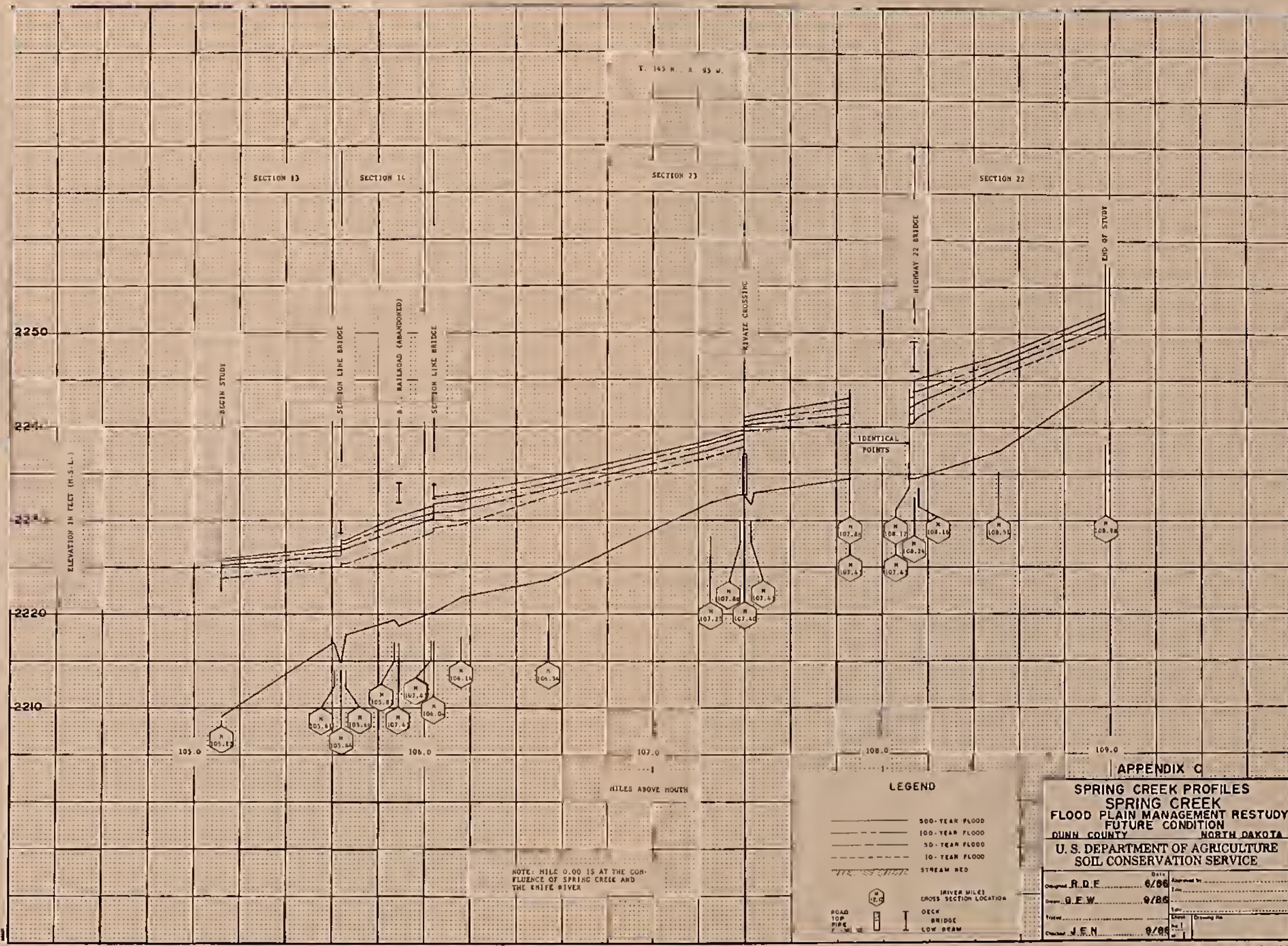
M-105.64 Sections 13 and 14, T. 145 N., R. 95 W.

M-107.40 Farm Drive in Section 23,
T. 145 N., R. 95 W.

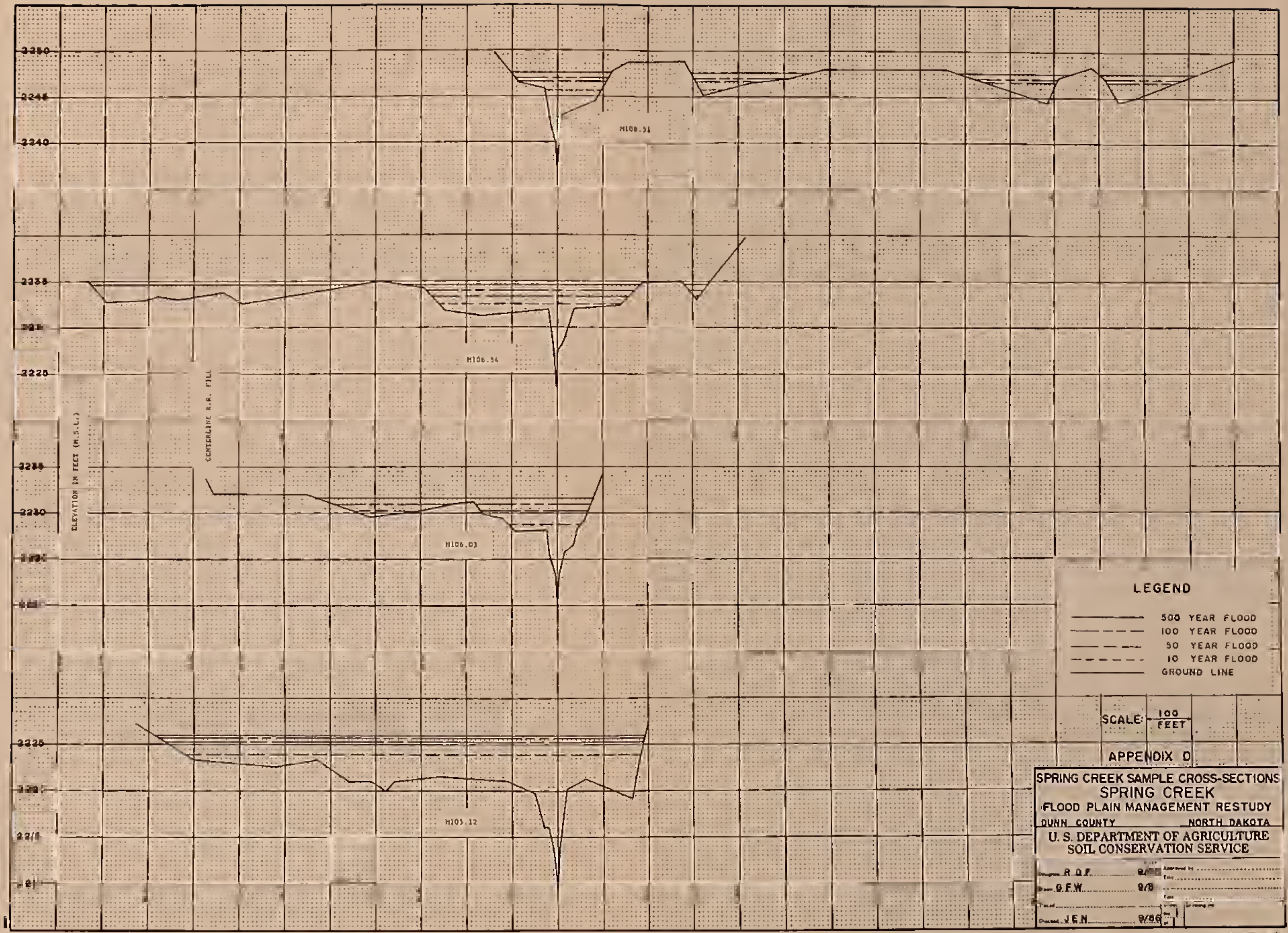
M-106.04 Sections 14 and 23, T. 145 N., R. 95 W.



T. 145 N., R. 95 W.
SECTION 13
SECTION 14
SECTION 23
SECTION 22
BEGIN STUDY
SECTION LINE BRIDGE
B.N. RAILROAD (ABANDONED)
SECTION LINE BRIDGE
PRIVATE CROSSING
PRIVATE CROSSING
TEMPORARY CROSSING
HIGHWAY 22 BRIDGE
END OF STUDY
ELEVATION IN FEET (M.S.L.)
2250
2240
2230
2220
105.0
106.0
107.0
108.0
109.0
MILES ABOVE MOUTH
NOTE: MILE 0.00 IS AT THE CONFLUENCE OF SPRING CREEK AND THE KNIFE RIVER.
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
(RIVER MILE) CROSS SECTION LOCATION
ROAD TOP PIPE
DECK BRIDGE LOW BEAM
APPENDIX C
SPRING CREEK PROFILES
SPRING CREEK
FLOOD PLAIN MANAGEMENT RESTUDY
PRESENT CONDITION (1986)
DUNN COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed R.D.E. 6/86
Drawn G.F.W. 9/86
Checked J.E.N. 9/86



SECTION 13
SECTION 14
SECTION 23
SECTION 22
BEGIN STUDY
SECTION LINE BRIDGE
RAILROAD (ABANDONED)
SECTION LINE BRIDGE
PRIVATE CROSSING
HIGHWAY 22 BRIDGE
END OF STUDY
IDENTICAL POINTS
ELEVATION IN FEET (M.S.L.)
2250
2220
2210
105.0
106.0
107.0
108.0
109.0
MILES ABOVE MOUTH
NOTE: MILE 0.00 IS AT THE CONFLUENCE OF SPRING CREEK AND THE KNIFE RIVER
LEGEND
500-YEAR FLOOD
100-YEAR FLOOD
50-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
(RIVER MILE) CROSS SECTION LOCATION
ROAD TOP PIPE
DECK BRIDGE LOW BEAM
APPENDIX C
SPRING CREEK PROFILES
SPRING CREEK
FLOOD PLAIN MANAGEMENT RESTUDY
FUTURE CONDITION
DUNN COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed R.D.F. 6/86
Drawn G.E.W. 9/86
Checked J.E.N. 9/86
FORM SCS-315 (NOV. 1966)



FORM SCS - 315 (NOV. 1966)

APPENDIX E

DISCHARGE-FREQUENCY DATA

SPRING CREEK

DUNN COUNTY

SPRING CREEK					
BETWEEN RIVER MILES	DRAINAGE AREA (SQUARE MILES)	500-YEAR FREQ. FLOOD Q (CFS)	100-YEAR FREQ. FLOOD Q (CFS)	50-YEAR FREQ. FLOOD Q (CFS)	10-YEAR FREQ. FLOOD Q (CFS)
105.12 - 108.98	35	2,460 1/	1,870 1/	1,350 1/	790 1/

1/ Reflects a breakout in Section 19, T. 145 N., R. 95 W.

WATER SURFACE ELEVATION - FREQUENCY DATA
SPRING CREEK
DUNN COUNTY
APPENDIX F

SPRING CREEK EXISTING CONDITION

RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
105.12	2225.9	2225.6	2225.2	2223.8
105.61	2227.1	2226.7	2226.2	2225.0
105.64	2227.9	2227.5	2227.0	2225.4
105.66	2227.9	2227.5	2227.0	2225.4
105.87	2230.3	2229.6	2228.8	2227.2
105.89	2230.9	2230.1	2229.1	2227.3
106.03	2231.7	2231.0	2230.2	2228.8
106.04	2232.7	2232.0	2230.9	2229.2
106.16	2232.9	2232.2	2231.2	2229.6
106.54	2234.7	2234.1	2233.4	2232.6
107.25	2238.6	2238.2	2237.6	2236.8
107.38	2239.6	2239.1	2238.5	2237.7
107.40	2241.0	2240.6	2240.2	2239.6
107.43	2241.3	2240.8	2240.4	2239.7
107.45	2241.8	2241.3	2240.7	2240.0
107.50	2242.1	2241.5	2241.0	2240.2
107.52	2242.6	2242.1	2241.6	2240.9
108.12	2244.6	2244.2	2243.7	2242.9
108.14	2245.8	2245.0	2244.2	2243.2
108.16	2245.8	2245.0	2244.2	2243.2
108.51	2247.7	2247.1	2246.7	2245.8
108.98	2252.4	2251.9	2251.2	2250.1

1/ Channel mile 0.0 is at the confluence of the Knife River.

APPENDIX G

INVESTIGATION AND ANALYSES

Surveys

A bench mark circuit was established throughout the study area using existing U.S.G.S. Coast and Geodetic Survey Bench Marks. Elevation reference marks are scattered throughout the study area. These reference marks can be used to determine flood elevations. Detailed locations, descriptions and elevations can be obtained from Appendix J. Third order levels were used as the base of accuracy in field surveys.

A total of 21 channel and flood plain cross sections were analyzed.

The geometry of all bridges and culverts was measured and used in computing the water surface profiles.

All cross sections within the study area are located on the photomaps (Appendix B, Sheets 1 & 2).

Photogrammetry

High level aerial photography flights were flown in June 1980. This photography was used for compilation of the final photo maps. Field surveyed cross sections were used to compute water surface profiles for the 10-, 50-, 100- and 500-year floods. The 100-year and 500-year curvilinear flood boundaries were field mapped using elevations computed from water surface profiles.

The peak discharges for the 10-, 50-, 100- and 500-year frequencies are based on a study of U.S.G.S. stream gage data from records of Spring Creek and nearby watersheds having similar hydrologic characteristics. Stations having the longest records used in this study include Spring Creek at Zap, Knife River at Golden Valley and Knife River at Hazen.

The drainage area used to determine peak discharges is 35 square miles. Water surface elevations for the 10-, 50-, 100- and 500-year flood events were computed using the U.S. Soil Conservation Service WSP-2 computer program, which performs subcritical backwater computations by a modified step method. The program includes head loss computations at restrictive sections such as roadway bridge openings or culverts.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen using U.S. Soil Conservation Service guidelines. The channel value selected was 0.045, while the flood plain value was 0.065.

Starting water surface elevations were taken from the Spring Creek Flood Hazard Analyses (1982).

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

The 100-year flood was computed to emphasize the effect of constrictions (bridge openings) on flooding and provide a basis for analyzing future improvements. Future projections indicate that expected encroachment will affect the flood stages a slight amount within the study area. The 100-year flood also serves as the base flood which FEMA considers as a minimum for flood insurance requirements.

APPENDIX H

ELEVATION REFERENCE MARKS

SPRING CREEK FLOOD PLAIN MANAGEMENT RESTUDY

R.M. No.	Elevation (MSL)	R.M.'s Description
S-81 2/	2229.81	A chiseled X on top of an I-beam piling on the wingwall, 4 feet from the northwest corner of a bridge over Spring Creek between Sections 13 and 14, T. 145 N., R. 95 W.
S-83 2/	2233.40	A chiseled X on top on an I-beam piling on the wingwall, 12 feet from the norhtwest corner of a bridge over Spring Creek between Sections 14 and 23, T. 145 N., R. 95 W.
L-82 1/	2241.702	A brass cap set in concrete approximately 82 feet north of the railroad station and 172 feet southwest of Main Street in Killdeer at the corner of Legion Park.
S-84A 2/	2251.56	A lag bolt set in the top of the north end of the west guard rail of the bridge over Spring Creek on ND Highway 22 between Sections 22 and 23, T. 145 N., R. 95 W.

1/ Reference marks established by the U.S.C. & G.S.
2/ Reference marks established by SCS.

APPENDIX I

SOILS

The soil information in this report is for only the flood plain area. The soils of Dunn County are mapped, described, and interpreted in greater detail in the "Soil Survey of Dunn County, North Dakota". Copies of this survey and help in using soil information are available from the local Soil Conservation Service Office in Killdeer, North Dakota.

INTERPRETATION OF SOILS

Interpretations are given in Table 1 for a number of uses.

Yield Per Acre

The average yields per acre that can be expected of spring wheat under a high level of management are shown in the table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; proper planting and seeding rates; use of suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and timely harvesting that insures highest profits. Dashes indicated crops not grown or not suited to the soil.

Land Capability Classification

Land capability classification shows the general suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the

soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland or engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman Numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants, require special conservation practices or both.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils have limitations that essentially preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter e, w, s, or c to the class numeral, for example, IIe.

The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In Class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s or c because the soils in Class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat or recreation.

Important Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nations's short and long-range needs for food and fiber. Prime farmland is the land best suited to producing food, feed, forage, fiber and oilseed crops. Prime farmland may be in pasture, crops, woodland or other land but it is not urban or built-up land or water areas.

Additional Farmland of Statewide Importance (AFSI) is land, in addition to prime farmlands that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Generally, Additional Farmlands of Statewide Importance include those that are nearly prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable.

Additional Farmlands of Local Importance are lands not designated prime or Additional Farmlands of Statewide Importance (AFSI) that can be protected from erosion and are capable of sustained production of the commonly grown crops. Additional Farmlands of Local Importance are designated by a unit of local government. The term "unit of local government" means the government of a county, municipality, town, township, village, or other unit of general government below the state level, or a combination of units of local government acting through an area-wide agency under state law or an agreement for the formulation of regional development policies and plans.

Soil Uses and Limitations

The soils are rated in Table 1 according to limitations that affect their suitability for playgrounds, picnic areas, dwellings with basements, septic tank absorption fields, sewage lagoons, fill materials for embankments and topsoil. The ratings are based on restrictive soil features such as wetness, slope and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, is the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, on-site assessment of the height, duration, intensity and frequency of flooding is essential.

The degree of soil limitation is expressed as slight, moderate or severe. Slight means that soil properties are generally favorable and that limitations can be overcome or alleviated by planning, design or special maintenance.

Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use or by a combination of these measures.

Dwellings

Ratings are made for small dwellings with basements on undisturbed soil. The ratings are based on soil properties, site features and observed performance of the soils. A high water table, flooding, shrink-swell potential and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Septic Tank Absorption Fields

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 to 72 inches is evaluated. The ratings are based on soils properties, site features and observed performance of the soils. Permeability, a high water table, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock, or a cemented pan interfere with installations.

Playgrounds

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Picnic Areas

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, not dusty when dry, not subject to flooding during the period of use and do not have slopes, stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Sewage Lagoons

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 1 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and generally 1 to 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock and cemented pans can cause construction problems and large stones can hinder compaction of the lagoon floor.

Embankments, Dikes, and Levees

Embankments, dikes and levees are raised structures of soil material constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of fill material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping and erosion, and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones, organic matter, salts or sodium. A high water table affects the amount of usable material.

Topsoil

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity and fertility. The ease of excavating, loading and spreading is affected by rock fragments, slope, water table, soil texture and thickness of suitable material. Reclamation of the borrow area is affected by slope, water table, rock fragments, bedrock and toxic material.

Soils rated good have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel and have slopes of less than 8 percent. They are low in content of soluble salts, are

naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated fair are sandy soils; loamy soils that have a relatively high content of clay; soils that have only 20 to 40 inches of suitable material; soils that have an appreciable amount of gravel, stones, or soluble salts; or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated poor are very sandy or clayey; have less than 20 inches of suitable material; have a large amount of gravel, stones or soluble salts; have slopes of more than 15 percent; or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

SPRING CREEK FLOOD PLAIN MANAGEMENT RESTUDY
DUNN COUNTY, NORTH DAKOTA
TABLE 1: SOIL INTERPRETATIONS FOR SELECTED USES

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category [2]	Spring Wheat Yield Bu/Ac [3]	Dwellings With Basements [1] [5]	Septic Tank Absorption Fields [1] [5]	Playgrounds [1]	Picnic Areas [1]	Sewage Lagoons [1] [4]	Dikes, Levees, Embankments [1]	Topsoil [1]
3	Straw loam, channeled	VIw	0	--	Severe: Flooding	Severe: Flooding	Severe: Flooding	Moderate: Flooding	Severe: Seepage, Flooding	Severe: Piping	Good
7	Straw-Rhoades loams		AFL1	23							
	Straw	IIc			Severe: Flooding	Severe: Flooding	Moderate: Flooding	Slight	Severe: Seepage, Flooding	Severe: Piping	Good
	Rhoades	VIs			Severe: Flooding Shrink-Swell	Severe: Flooding Percs Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Severe: Flooding	Severe: Hard to Pack, Excess Sodium	Poor, Excess Sodium
13D	Wabek gravelly loam, 1 to 15 percent slopes	VIs	0	--	Moderate: Slope	Severe: Poor Filter	Severe: Slope	Moderate: Slope	Severe: Seepage, Slope	Severe: Seepage, Piping	Poor: Small Stones, Area Reclaim
18	Belfield-Grail silty clay loams 1 to 3 percent slopes		AFS1	24							
	Belfield	IIIs			Severe: Shrink-Swell	Severe: Percs Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Moderate: Slope	Severe: Excess Sodium	Poor: Excess Sodium
	Grail	IIc			Moderate: Shrink-Swell	Severe: Percs Slowly	Moderate: Slope	Slight	Moderate: Slope	Moderate: Piping, Hard to Pack	Poor: Thin Layer
30E	Cohagen-Vebar fine sandy loams, 9 to 25 percent slopes		0	--							
	Cohagen	VIe			Severe: Depth to Rock, Slope	Severe: Depth to Rock, Slope	Severe: Slope, Depth to Rock	Severe: Slope, Depth to Rock	Severe: Seepage, Depth to Rock, Slope	Severe, Piping	Poor: Area Reclaim, Slope
	Vebar	VIe			Severe: Slope	Severe: Depth to Rock, Slope	Severe: Slope	Severe: Slope	Severe: Seepage, Depth to Rock, Slope	Severe: Piping	Poor: Slope
32B	Flaxton-Williams complex 1 to 6 percent slopes		AFSI	21							
	Flaxton	IIIe			Moderate: Shrink-Swell	Severe: Percs Slowly	Moderate: Slope	Slight	Severe: Seepage	Severe: Piping	Good
	Williams	IIe			Moderate: Shrink-Swell	Severe: Percs Slowly	Moderate: Slope	Slight	Moderate: Seepage, Slope	Moderate: Piping	Fair: Large Stones
44B	Lihen loamy fine sand 1 to 6 percent slopes	IVe	AFS1	13	Slight	Severe: Poor Filter	Moderate: Slope, Small Stones	Slight	Severe: Seepage	Severe: Piping	Fair: Too Sandy Small Stones
44D	Lihen loamy fine sand, 6 to 15 percent slopes	VIe	0	--	Moderate: Slope	Severe: Poor Filter	Severe: Slope	Moderate: Slope	Severe: Seepage, Slope	Severe: Piping	Fair: Too Sandy, Small Stones
54B	Parshall fine sandy loam, 1 to 6 percent slopes	IIIe	AFSI	21	Slight	Slight	Moderate: Slope	Slight	Severe: Seepage	Severe: Piping	Good
62B	Rhoades silt loam, 1 to 6 percent slopes	VIs	0	--	Severe: Shrink-Swell	Severe: Percs Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Moderate: Depth to Rock, Slope	Severe: Excess Sodium	Poor: Excess Sodium
75	Straw loam	IIe	P	31	Severe: Flooding	Severe: Flooding	Moderate: Flooding	Slight	Severe: Seepage, Flooding	Severe: Piping	Good

TABLE 1: SOIL INTERPRETATIONS FOR SELECTED USES

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category 1/ 2/	Spring Wheat Yield Bu/Ac 3/	Dwellings With Basements 1/ 4/	Septic Tank Absorption Fields 1/ 2/	Playgrounds 1/	Picnic Areas 1/	Sewage Lagoons 1/ 4/	Dikes, Levees, Embankments 1/	Topsoil 1/
79	Velva fine sandy loam, 1 to 3 percent slopes	IIIe	AFSI	22	Severe: Flooding	Severe: Flooding	Moderate: Flooding	Slight	Severe: Seepage, Flooding	Severe: Piping	Good
81C	Vebar-Parshall fine sandy loams, 6 to 9 percent slopes		AFLI	18							
	Vebar	VIe			Moderate: Depth to Rock	Severe: Depth to Rock	Severe: Slope	Slight	Severe: Seepage, Depth to Rock, Slope	Severe: Piping	Fair: Area Reclaim Thin Layer
	Parshall	IVe			Slight	Slight	Severe: Slope	Slight	Severe: Seepage, Slope	Severe: Piping	Good
81D	Vebar fine sandy loams, 9 to 15 percent slopes	VIe	0	--	Moderate: Depth to Rock, Slope	Severe: Depth to Rock	Severe: Slope	Moderate: Slope	Severe: Seepage, Depth to Rock, Slope	Severe: Piping	Fair: Area Reclaim Thin Layer, Slope
94E	Wayden silty clay, 9 to 25 percent slopes	VIIe	0	--	Severe: Depth to Rock, Shrink-Swell	Severe: Depth to Rock, Slope	Severe: Slope, Depth to Rock	Severe: Slope, Depth to Rock	Severe: Depth to Rock, Slope	Severe: Thin Layer	Poor: Area Reclaim, Too Clayey, Slope
105	Harriet silt loam	VIs	0	--	Severe: Flooding, Wetness	Severe: Flooding, Wetness, Percs Slowly	Severe: Wetness, Percs Slowly, Excess Sodium	Severe: Wetness, Percs Slowly Excess Sodium	Severe: Flooding, Wetness	Severe: Piping, Wetness, Excess Sodium	Poor: Wetness Excess Sodium

1/ Soil interpretations Dunn County, North Dakota prepared by USDA SCS, 1982.

2/ P=prime, PWD=prime where drained, AFL1=additional farmlands of local importance.

3/ All yields are for drained areas of the poorly drained and very poorly drained soils.

4/ Construction of dwellings, septic tanks and sewage lagoons is not recommended in the flood plain. However, if construction is necessary the developer should consider the flood hazard and soil restrictions presented in this report.